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U.S. Nuclear Regulatory Commission
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Quad Cities Nuclear Power Station, Units 1 and 2
Renewed Facility Operating License Nos. DPR-29 and DPR-30
NRC Docket Nos. 50-254 and 50-265

Subject: Additional Information Regarding Request for License Amendment to Revise Loss of Voltage Relay Settings

References:

1. Letter from P. R. Simpson (Exelon Generation Company, LLC) to U.S. NRC, "Request for License Amendment to Revise Loss of Voltage Relay Settings," dated September 12, 2016

2. Letter from K. J. Green (U.S. NRC) to B. C. Hanson (Exelon Generation Company, LLC), "Quad Cities Nuclear Power Station, Units 1 and 2 – Request for Additional Information Concerning Proposed Changes to Revise Loss of Voltage Relay Settings (CAC Nos. MF8381 and MF8382) (RS-16-162)," dated March 8, 2017

In Reference 1, Exelon Generation Company, LLC (EGC) requested an amendment to Renewed Facility Operating License Nos. DPR-29 and DPR-30 for Quad Cities Nuclear Power Station (QCNPS), Units 1 and 2, respectively. The proposed change revises the allowable value for Function 1, "4160 V Essential Service System Bus Undervoltage (Loss of Voltage)," in Technical Specifications (TS) Table 3.3.8.1-1, "Loss of Power Instrumentation."

The NRC requested additional information that is needed to complete review of the proposed change in Reference 2. In response to this request, EGC is providing the attached information.

EGC has reviewed the information supporting a finding of no significant hazards consideration, and the environmental consideration, that were previously provided to the NRC in Attachment 1 of Reference 1. The additional information provided in this submittal does not affect the bases for concluding that the proposed license amendment does not involve a significant hazards consideration. In addition, the additional information provided in this submittal does not affect the bases for concluding that neither an environmental impact statement nor an environmental assessment needs to be prepared in connection with the proposed amendment.

There are no regulatory commitments contained in this letter. Should you have any questions concerning this letter, please contact Mr. Kenneth M. Nicely at (630) 657-2803.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 24th day of April 2017.

Respectfully,

Patrick R. Simpson
Manager – Licensing

Attachment: Response to Request for Additional Information

cc: NRC Regional Administrator, Region III
NRC Senior Resident Inspector – Quad Cities Nuclear Power Station
Illinois Emergency Management Agency – Division of Nuclear Safety

ATTACHMENT
Response to Request for Additional Information

NRC Request 1

On page 2 of Attachment 1 of the LAR, EGC has provided a summary of the problem statement and states, "[t]he concern was that, if the voltage at the 4.16 kV [kilovolt] safety related buses dropped to slightly above 75 percent of the nominal voltage, the operating motors would experience approximately a 28 percent increase in current." Exelon has further stated that, "[t]his voltage drop, complicated by potential motor starts, including the potential start of the motor-driven auxiliary feedwater pump if a plant trip occurred, could result in adverse consequences that had not been evaluated." The LAR does not discuss the impact of large motor starting during degraded voltage conditions and how the proposed setpoint of the LOV relays will preclude complications during plant shutdown.

a. Please provide details, including assumptions used, on the Quad Cities voltage drop evaluation that was performed to demonstrate the adequacy of the proposed LOV setpoint in combination with the existing setpoints (voltage and time) of the degraded voltage relay (DVR) for protecting safety related equipment following a plant trip and large motor (e.g., feedwater pump, drywell coolers, service water pumps) starts.

b. Please confirm if this voltage drop evaluation enveloped any process-related demand for a large motor start that can occur during the required design basis operational modes such as normal plant operation, controlled shutdown, anticipated operational occurrences or post-accident conditions with a unit trip and a fast bus transfer to the reserve auxiliary transformer. If the evaluation did not consider these, please explain why the proposed LOV relay settings are adequate. The staff notes that UFSAR Table 8.3-2 identifies that the CRD pump and service water pump are manually started after 10 minutes.

Response

The evaluation performed only addressed those safety related components required for safe shutdown of the plant in order to validate their continued functionality during the proposed low voltage scenario. The NRC safety evaluation supporting Amendments 77 and 71 for Quad Cities Nuclear Power Station (QCNPS) Units 1 and 2, respectively, (i.e., Reference 1) state in sections 3.0 (Item 1) and 4.0 (Item 3) that large motor starts and grid disturbances were considered and found acceptable without causing spurious trips of the relays.

Calculation 9390-02-19-1, "Diesel Generator 1 Loading Under Design Bases Accident Condition," Revision 3, and similar calculations for the other emergency diesel generators (EDGs), evaluated bus voltages at 55% (2288 V) and demonstrated adequate recovery from voltage dips following large motor starts, which demonstrates significant margin to the proposed 3952 V. The calculation evaluated EDG loading during the most limiting starts of the largest motors. No protective devices are expected to operate per the conclusions of these analyses, as the voltage dips are expected to be one second in duration. Subsequent manual starts of equipment under operator control will assess loading at the time that motor starts are required.

NRC Request 2

The NRC staff reviewed LAR Attachment 3, "Design Analysis QDC-6700-E-2173, 'Evaluation of Degraded Voltage 5 Minute Timer on Normally Running Safety-Related Loads,'" Revision 000, and made the following observations:

- Page 3 of 18 provides a listing of emergency core cooling system (ECCS) room coolers which are considered as "the only directly connected safety-related motors that may be running during normal operation." The staff notes that loads such as drywell coolers, service water pump, and control room air handling units (AHU) or heating, ventilation and air conditioning (HVAC) systems are not included in the list.

- Page 8 of 18 states that the analysis will evaluate the safety-related motors that may be running during normal conditions during a severely degraded voltage condition that lasts for an extended period of time.

- Page 9 of 18 states that there are no normally running, safety-related 480 V switchgear motors or 4.16 kV switchgear motors.

- The Updated Final Safety Analysis Report, Chapters 6 and 9, provide details on equipment that may be operational during normal plant operation and/or shutdown.

The NRC staff notes that grid-related degraded voltage conditions can occur at any time during normal plant operation, controlled shutdown, anticipated operational occurrences or post-accident conditions and impact redundant trains of equipment. The evaluation included in the LAR considered only the ECCS-related AHU loads. The staff notes that there are other motors that are connected to switchgear buses and may be running during normal plant operation but were not evaluated for degraded voltage conditions in the analyses provided. Please confirm the following:

a. The ECCS room coolers are single packaged units containing fans, coils, filters, dampers air conditioning compressors, etc., and external chillers or compressors are not required for room cooling and are therefore not considered in the DVR and LOV relay setpoint analyses.

b. If any control room related HVAC systems are normally operating and any compressors or chillers are required during normal operation and plant shutdown for postulated events.

c. Degraded voltage conditions resulting from grid-related events can occur on redundant safety buses and can adversely impact redundant equipment. Please explain if pumps and motors associated with cooling water systems such as station service water, reactor building closed cooling water, drywell coolers, etc., have been evaluated for low voltage conditions similar to the AHUs discussed in the LAR. If the loss of motors associated with cooling water systems have not been evaluated, then please confirm if loss of redundant trains of cooling water systems for an extended duration can adversely impact the plant systems during normal operation or during controlled shutdown with no accident signal postulated and station buses connected to offsite power.

Response

a. The ECCS room coolers are self-contained units. All components are contained within the room cooler. The only external components for room cooler operation are the power supplies, cabling and cooling water piping.

b. The QCNPS Control Room HVAC system consists of two independent trains. The Control Room HVAC system trains are described in UFSAR Section 6.4.2.2 and 9.4.1.2. Train A Control Room HVAC is the normally operating Control Room HVAC system during normal operation. Train A is considered non-safety related and is powered from a non-safety related bus. Train B Control Room HVAC is safety-related and is powered from a safety-related bus (i.e., MCC 18-1). In the event of a LOCA/LOOP, the power to the Train A system would be lost and the Train A system would trip. The trip of the Train A Control Room HVAC system would cause an automatic start of the Train B Control Room HVAC air handling unit. The Train B Control Room HVAC air conditioning compressor and the air filtration unit would need to be manually started within 40 minutes in accordance with the UFSAR description in Section 6.4.4.1.

   As described in UFSAR section 6.4.4.1, "Radiation protection is provided to allow control room access and occupancy for the duration of a DBA." UFSAR Section 6.4.3 also states, "Train B is operable during a loss of either offsite power or instrument air." Therefore, Train B Control Room HVAC is required and designed to be available for postulated events. Since the Train A Control Room HVAC is the train that is used for normal operation, then the same Control Room HVAC Train is not required for both normal operation and plant shutdown for postulated events.

c. During normal plant operation, safety related cooling water pumps and motors powered from the class 1E system would not be expected to be running unless system surveillances are in progress. A controlled shutdown of a unit with no accident signal present will take hours to complete. As such, if the degraded voltage condition does not clear within five minutes, the five minute time delay function relay sends a loss of power signal to the respective bus load shedding scheme and starts the associated EDG. During a controlled unit shutdown with no accident signal present, the degraded voltage five minute time delay relay would have started the EDGs before safety related cooling systems would be required. Also, as part of the controlled unit shutdown, large non-safety related loads (i.e., feedwater pump, circulating water pump, condensate pump) will be removed from service which will improve the degraded voltage condition.

NRC Request 3

Section 3.3.1 of Attachment 3 to the LAR states, "The results of the transient EDG [emergency diesel generators] voltage dip analyses from diesel loading calculations 9390-02-19-1, 9390-02-19-2, and 9390-02-19-3 are used in this calculation. The QCNPS Unit 1, Unit 2, and 1/2 diesel loading calculations are *not maintained* (emphasis added) and have been superseded by ETAP calculation QDC-6700-E-1503 ... Furthermore, an exact value for the transient voltage dip is not needed as the results are used to show that margin exists between LOV relay setpoint

and the transient voltage dips." The NRC staff understands that raising the LOV relay setpoint can potentially impact EDG operation.

a. Please explain the use of unmaintained diesel loading calculations for input into calculations maintained by a 10 CFR Appendix B "Design Control" program.

b. Please provide details on the margin between LOV relay setpoint and the largest voltage transient observed during motor starting.

c. QCNPS TS surveillance requirements such as 3.8.1.2 and 3.8.1.8 require that a minimum EDG steady state voltage of 3952 V be verified. Please confirm that the EDG voltage transient dips were evaluated based on a starting voltage of 3952 V and unlike the DVR setpoint analyses, an infinite bus is not connected to each of 4.16 kV essential service system buses in order to model a specific operating voltage.

Response

a. As described in calculation QDC-6700-E-2173, use of the transient voltage dip analyses from the unmaintained diesel loading calculations was based on engineering judgment. This assumption is acceptable because the information is only used to show there is margin between the LOV relay setpoint and the transient voltage dips (i.e., as discussed below). The voltage dip analyses have been superseded by ETAP calculation QDC-6700-E-1503, and any future changes to the EDG loading analysis for DBA conditions would be incorporated into calculation QDC-6700-E-1503. In addition, use of this assumption is justifiable because the loading on the EDGs and the sequence of automatic large motor starts seldom change. However, if a significant change were to occur, the impact to calculation QDC-6700-E-2173 would be evaluated under EGC's design control processes to confirm the acceptability of the continued use of the engineering judgement assumption.

b. As discussed on pages 17 and 18 of calculation QDC-6700-E-2173, both LOOP/LOCA and LOOP without LOCA scenarios have been analyzed. For each EDG during the LOOP/LOCA scenario, voltage recovers to more than 84% of 4.16 kV (3494 V) within one second following the start of any large 4 kV motor. For the LOOP without LOCA, voltage recovers to more than 3494 V within one second following the start of the Residual Heat Removal Service Water pump motor. Therefore, the 4.16 kV ESS bus voltage will recover above 3494 V within one second following the largest expected EDG voltage transient. Page 18 of the calculation shows that the upper analytical limit for the LOV relay is 3246 V. Therefore, the margin between the LOV relay setpoint (i.e., when at +5% of the nominal setpoint) and the largest voltage transient is 248 V (i.e., 3494 V - 3246 V).

c. The ETAP runs are performed at both 4160 V (100%) bus voltage and 3845 V bus voltage, and demonstrate that the voltage dip after the large motor starts will adequately recover. This bounds the normal operating voltage band down to 3952 V, and provides margin.

NRC Request 4

In response to the request for supplemental information, EGC sent a letter dated November 21, 2016 (ADAMS Accession No. ML16326A200). Exelon's response addressed clarifications regarding assumptions and provided a drift analysis. The NRC staff observed that the drift analysis did not identify how as-found values which are outside the allowed tolerances are addressed. Provide additional information to clarify how out of tolerance values are addressed. This information is requested to confirm compliance with 10 CFR 50.36(c)(ii)(A) and the guidance of Regulatory Guide 1.105, Revision 3.

Response

As-found setpoint values that are found outside of the allowed tolerances during calibration are adjusted to a value within the as-left tolerance using the applicable relay calibration procedure. The as-found data is addressed in accordance with procedure ER-AA-520, "Instrument Performance Trending." This procedure requires an Issue Report to be initiated in the Corrective Action Program when surveillance testing identifies that an instrument is out of tolerance. Under the Corrective Action Program, the out of tolerance instrument is evaluated to determine the impact on operability. Procedure ER-AA-520 requires specific trend code information to be included in Issue Reports for out of tolerance instruments to facilitate periodic trend reviews under the As-Found/As-Left Program. In some trending cases, instrument replacement is warranted.

The As-Found/As-Left Program is used to maintain a continuing evaluation of instrument drift based on calibration data and to incorporate any increase in observed drift into appropriate calculations. Specifically, Design Engineering personnel update the drift analysis for instrumentation using new calibration data (i.e., including out of tolerance as-found values identified during surveillance testing) once each operating cycle (i.e., every 24 months) to determine if instrument drift trends from this period, and previous periods, invalidate the drift determination or analysis enough to warrant an adjustment to the drift error data provided in the instrument setpoint calculations. If warranted, setpoint calculations are adjusted to reflect new setpoints and tolerances based on the instrument drift data.

Results of the most recent periodic update of the drift analysis for the LOV relays were previously submitted to the NRC in Reference 2. Additional information regarding the As-Found/As-Left Program is discussed in Appendix J, "Guideline for the Analysis and Use of As-Found/As-Left Data," of NES-EIC-20.04, "Analysis of Instrument Channel Setpoint Error and Instrument Loop Accuracy," which has been approved by the NRC for use at QCNPS as discussed in Reference 2.

References

1. Letter from D. M. Crutchfield (U.S. NRC) to L. DelGeorge (Commonwealth Edison Company), "Degraded Grid Voltage Protection," dated May 19, 1982

2. Letter from P. R. Simpson (Exelon Generation Company, LLC) to U.S. NRC, "Supplemental Information Regarding Request for License Amendment to Revise Loss of Voltage Relay Settings," dated November 21, 2016